

**ACCESSIBILITY STUDY FOR MAGLEV BASED TRANSIT
IN NEW DELHI**

A

PROJECT REPORT

*Submitted in partial fulfillment of the requirements for the award of
the degree*

Of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision

Of

Dr. Tanmay Gupta

(Assistant Professor Grade-ii)

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To



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HIMACHAL PRADESH, INDIA

JUNE – 2020

STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled **“ACCESSIBILITY STUDY FOR MAGLEV BASED TRANSIT IN NEW DELHI”** submitted for partial fulfillment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Dr. Tanmay Gupta (Assistant Professor Grade-ii)**. This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

A handwritten signature in blue ink that reads "Alex". The signature is enclosed within a large, hand-drawn oval shape.

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June 2020

CERTIFICATE

This is to certify that the work which is being presented in the project report titled **“ACCESSIBILITY STUDY FOR MAGLEV BASED TRANSIT IN NEW DELHI”** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Wagnaghat** is an authentic record of work carried out by **Alakshender Singh Wazir (161655)** during a period from August, 2019 to June, 2020 under the supervision of **Dr. Tanmay Gupta** Department of Civil Engineering, Jaypee University of Information Technology, Wagnaghat.

The above statement made is correct to the best of our knowledge.

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ABSTRACT

This report spawned from the idea of the seminar conducted on **MAGLEV LEVITATION LOCOMOTIVES IN RAILWAY ENGINEERING** in which the requirements and factors surrounding a rapid transit system were discussed thoroughly. The starting point of every civil engineering endeavor is the planning phase in which surveys are performed in an area which assess the feasibility of a potential project. The surveys are geographic/geometric. Processes such as construction and materials and cost are generally prioritized, but one of the behemoth phases, which is the planning phase is vastly ignored and can be the difference between success and failure.

The Planning phase.

Infographic analysis which assesses an area's socio economic parameters like population, employment, poverty, traffic feeds by combining it with geo-spatial data is what comes under the planning phase. Whenever a transit project is considered, these factors claim the highest importance in the planning phase because these factors will decide the area that is to be selected for the commencement. Sadly, this infographic based planning is often overlooked due to several governmental reasons in India. Either the area for development is chosen by political factors in that particular area, or only the bigger cities are focused owing to the budget which is allocated. This is where a recent technology by the name of **GIS** is implemented. It aims at analyzing a current transit system and showing the areas which are in actual need of a new one through infographic analysis. In this report, a similar project is taken and analyzed for the places which it fails to serve and from those places, the region with the highest requirement and which offers the highest feasibility is chosen using a GIS software. Many sub processes which are discussed as chapters will be forthcoming in the report and the resulting areas determined by the software will be the target places for the transit system.

KEYWORDS USED: GIS, ESRI, GTFS.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

The planning of any public transit process requires the knowledge of the social and economic indices of a concerned area. This is where the need for a software based system enters. It is difficult to perform manned surveys of a region and tiresome to gain access to census data. In this day of vast modern technology, when everything is available with a touch of a button, planning of the route is done using a new technology known as GIS or Geographic Information System to expand on this construct.

This technology takes spatial data and populates it with geo-infographic data taken from social and economic census of all the world countries. For this particular project, ArcGIS, developed by ESRI technologies will be used. This technology is not in use in India for any contemporary transit project but is slowly being used in rapid transit projects. Therefore, this new software based method of route planning will be explored in the form of a pilot study. No report is complete without studying the parent reports which give an insight to the current practices. The literature involved in the insight provision of this report are mentioned in a table below.

Abbreviations used : GIS (geographical information system), ESRI (Environmental Systems Research Institute), GTFS (general transit feed specification).

1.2 OBJECTIVES

1. Understanding the Need for General Transit Data
2. Performing analysis of use of Current Transit system in New Delhi
3. Recognizing areas in need of a new transit system
4. Understanding the effect of demographic data on planning
5. Formulation of a new transit route

CHAPTER 2

LITERATURE REVIEWS

2.1 Reviews

1. Alexander, Princy (23 September 2013).

The use of Geographic Information System in the planning process is explained. Talks about GIS in a passive phase i.e. only using it statically for a single variable such as monitoring of traffic and routes, one at a time.

2. Agarwal, Kabir (6 May 2017).

The use of Infographic data based on social indices like population in planning is explained.

3. Michael, Gebicki (27 November 2014).

Parent paper which propelled the idea of route planning for efficient Public transit system.

4. Eman, Borhan (20 June 2017).

Data regarding the Indian railway transit system is highlighted.

2.2 Summary

An important and passive role was played by these research papers towards contribution in this report. Ideas of certain aspects spawned from these papers but the content of this report is based on a personal and thorough learning of the software involved in the coalition of all these minor aspects towards making an accessibility representation.

CHAPTER 3

GIS

Indian Railways (IR) [1] is India's national railway system operated by the Ministry of Railways. It caters to the fourth largest railway network in the world by size, with a route length of 67,370-kilometre (41,861 mi) and total track length of 121,400-kilometre (75,439 mi) as of March 2017. The above numbers might seem satisfactory in terms of fulfillment of transportation needs of the country but the real situation is far from simple. Problems with the current railway system:

Safety: Indian Railways have been in the news for wrong reasons. With the rapid increase in passenger and goods traffic, the frequency of train accidents is increasing very fast. This has raised serious doubts in the public mind about safety of Rail travel and the general railway network health. On an average the Railways report 20 major collisions, 350 derailments and around 80 level crossing accidents in a year.

Cost and Revenue Problems: As is the case with most of the government organizations, Indian Railways face long term financial crisis. The annual rate of increase in cost has overtaken that of returns during the last few years. A study of Railways finances from 1998 to 2004 reveals that the revenues increased at an average annual rate of 8.7 per cent against the 9.65 per cent average annual growth in costs. [1]

Social Burden: Railways are often associated with a social responsibility of connecting places with different ethnicities and the improper functioning of the railways leads to an increased socio-political pressure. The aforementioned problems are a result of improper planning. The planning phase of any project includes many studies such as geographical study, accessibility study which includes a feasibility study. A common problem in every transportation project of India is improper accessibility study.

ACCESSIBILITY STUDY ASSESSES **the socio-economic status of an area**. A project for a socially and economically backward region is more important than an already developed region. **The area with a high traffic inflow and outflow**. A good railway line is precisely serving an area where traffic problems persist.

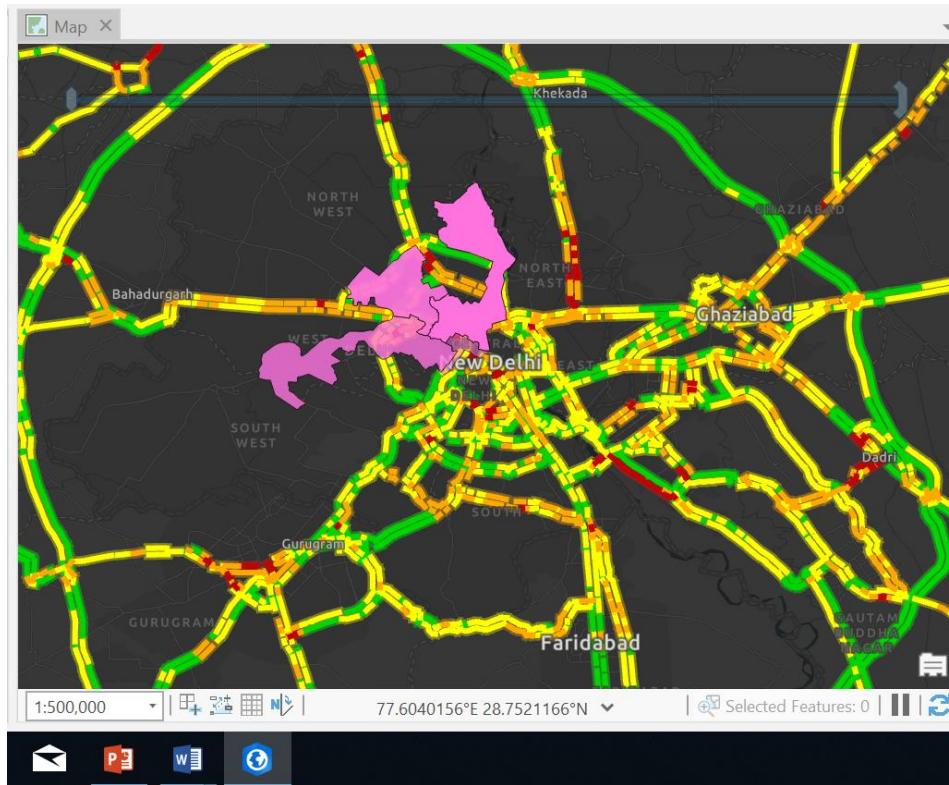


Fig 3.1 WORLD TRAFFIC SERVICE around New Delhi (self-generated)

The figure clearly illustrates the facts. New Delhi transit stations serve an area with a light to moderate traffic condition but the areas with high traffic are devoid of any such system and clearly the roads in those regions are doing no service. Therefore, it is important to turn our attention to these regions and perform an accessibility study of this high traffic region for a future high speed transit project (MAGLEV) and see whether or not the new transit system would perform well or not.

In the previous presentation it was shown that a MAGLEV project's construction is easier and more cost friendly than a regular transit system's. But before we jump into the cost of construction, we need to decide the route. This study will not only show how a new method of route selection **is** used and **can be** used but will also show that we can accurately depict the socio-economic requirements of a selected route through a pilot study.

Every department in the world related to a transport service has some data regarding the stops and routes and timings of their transit system. This is known as **GTFS** (General Transit Feed Specification). It is basically a compressed file containing the written code (in python) which can be used to be converted into spatial data. A software which can convert this text file into representable spatial data where it can be displayed over geographic data is required.

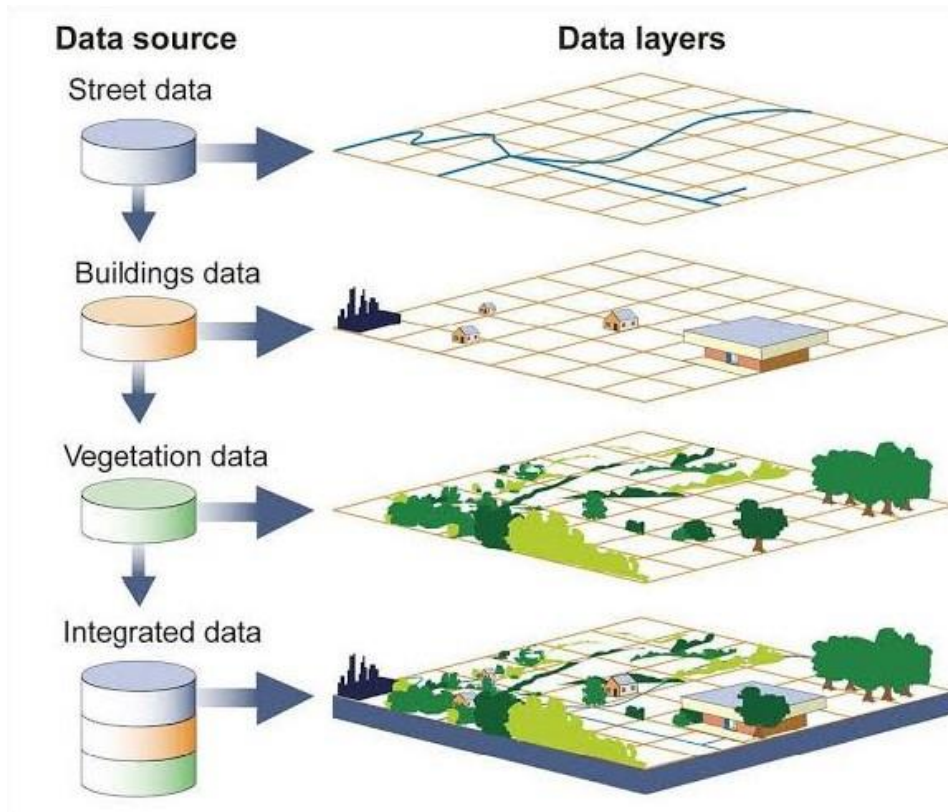


Fig 3.2 GIS [2]

This is the gap fulfilled by ArcGIS. This technology is not in use in our country for any contemporary transit project but is slowly being used in rapid transit projects. GIS manages spatial and demographic data to improve the planning process of a project. There are various websites which provide transit feed data since this information is public and can be accessed by any engineer/researcher. However, sometimes, the data needs to be altered according to the limits of the software. ArcGIS can only process a 1000 stops at a time. Therefore, the extra stops have to be personally removed from the feed. The world traffic service layer can be used to eliminate stops which lie over low traffic regions since they are not of significance in this accessibility report.

CHAPTER 4

NEW DELHI TRANSIT STATION ANALYSIS

New Delhi transit stretches along a small portion: 30 kilometers and serves a very small radius of a few kilometers. The project is to consider adding a new train route (maglev route) by assessing the areas in the city which are in the most need of a new transit system. The plan of action will be: **MAP EXISTING TRAIN SERVICE, MAP AREAS AROUND THE STATIONS WHICH ARE AT A WALKING TIME OF 15 MINUTES.**

It begins by mapping the current train stops in New Delhi and the areas of the city that are within a 15-minute walk of these stops. Train Stop features from **GTFS** (General Transit Feed Specification) data [3] are created. On Transitland Feed registry site searches for New Delhi are made. The compressed file is downloaded and extracted. In ArcGIS pro, under “Template” select Map. A map appears based on personal regional settings. Locate command is accessed under map template, and search for New Delhi is made.

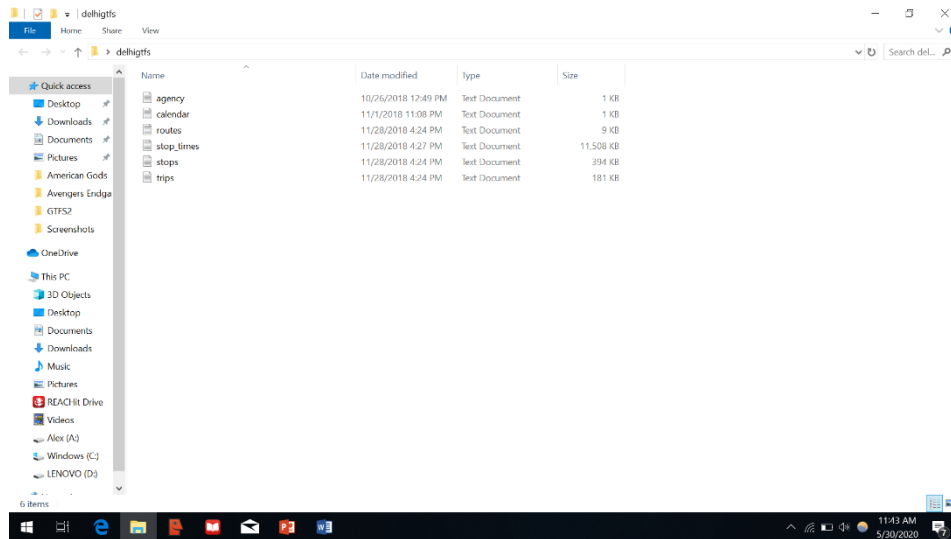


Fig 4.1 GTFS files (self-generated)

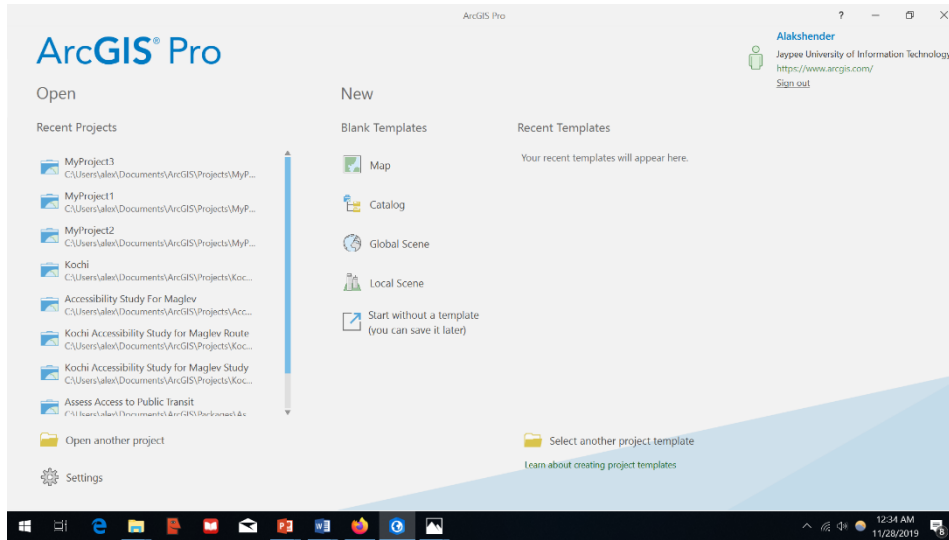


Fig 4.2 ArcGIS homepage (self-generated)

Next, the stops text file from the GTFS dataset will be converted into features that can be viewed and processed on the map. Under the geoprocessing pane, search is made for “GTFS stops to features” and under input file name, the location of the “stops.txt” file is entered and under output feature name, “TrainStops” is entered. Program is Run. The “TrainStops” layer will be created in the contents pane and will populate the map.

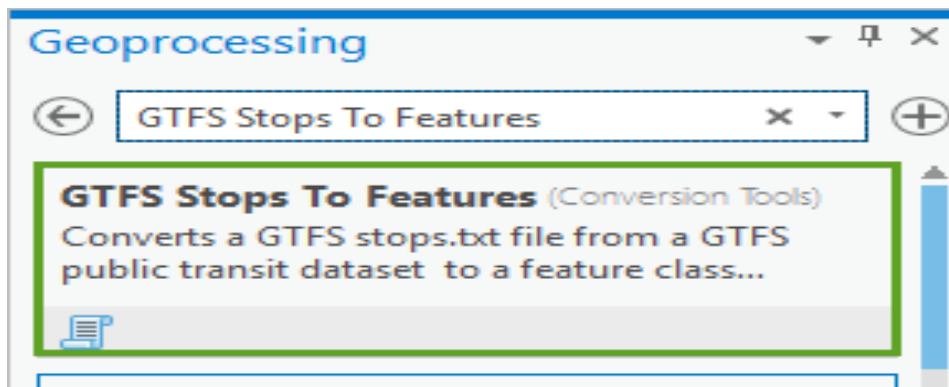


Fig 4.3 GTFS Stops to Features (self-generated)

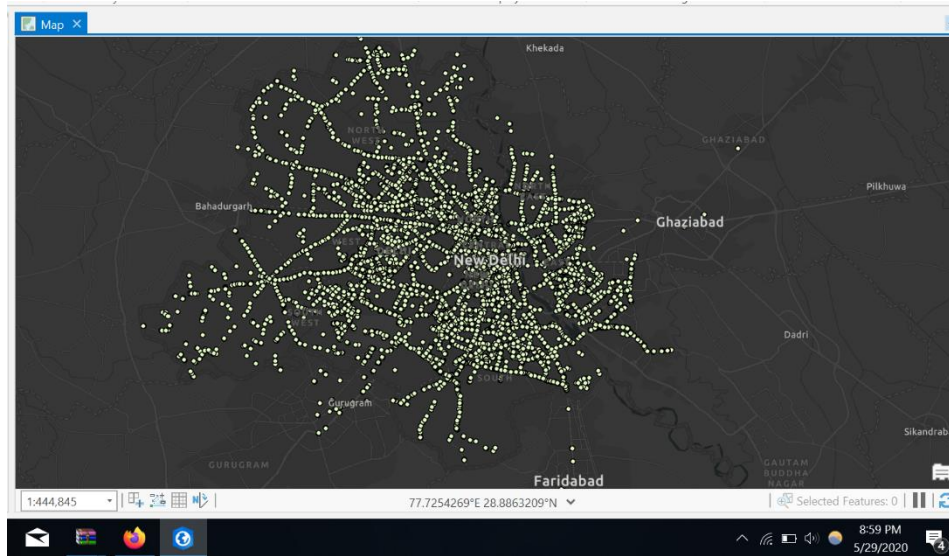


Fig 4.4 TrainStops (self-generated)

In the Maps section, Basemap to Black Grey Canvas. This shows a view which is easy on the contrast of the stops which are populated. This stops are showing actual stops served by the current transit system of DTC (Delhi Transport Corporation). A new layer gets created in the contents pane which can be deactivated by de selection. Color of the stops can be changed and the properties of the stops can be varied. The stops are huge in number and in the next chapters, they will be filtered to show only over a certain area since the limit of the software is only a 1000 stops.

CHAPTER 5

SERVICE AREA GENERATION

There is a need to represent the stops populated on the map as facilities. In Network Analysis pane in the analysis tab, service areas is selected. It is made sure that the Network Dataset is set to the official ArcGIS URL which means that some features on the ArcGIS software will use credits. The Service area pane in the toolbar is selected, and Import Facilities is clicked. Same is repeated for the World Traffic Service layer. The stops on the map will now appear as shown in Fig 5.3. Living Atlas in the Geoprocessing pane is turned on, selected and Indian Subdistricts is entered in the search field and right clicked and added to the current map.

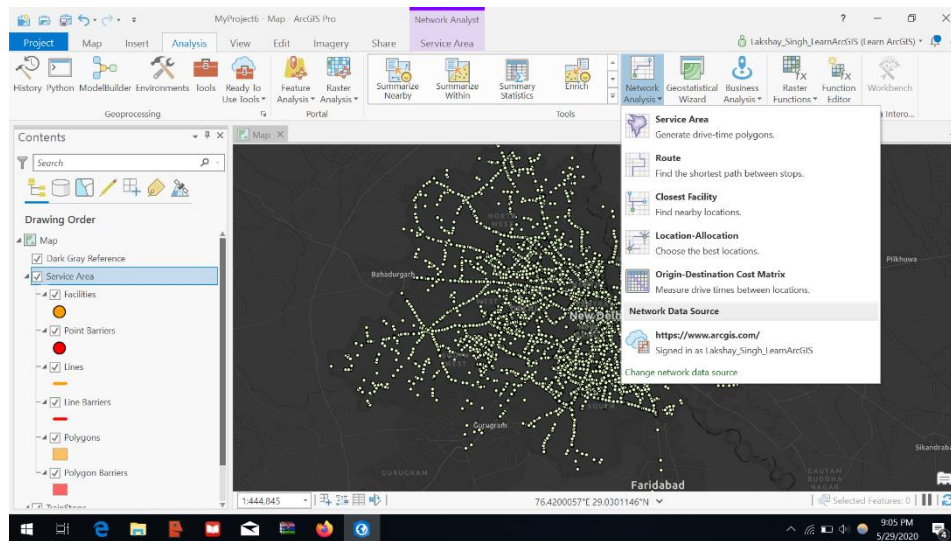


Fig 5.1 Facilities generation (self-generated)

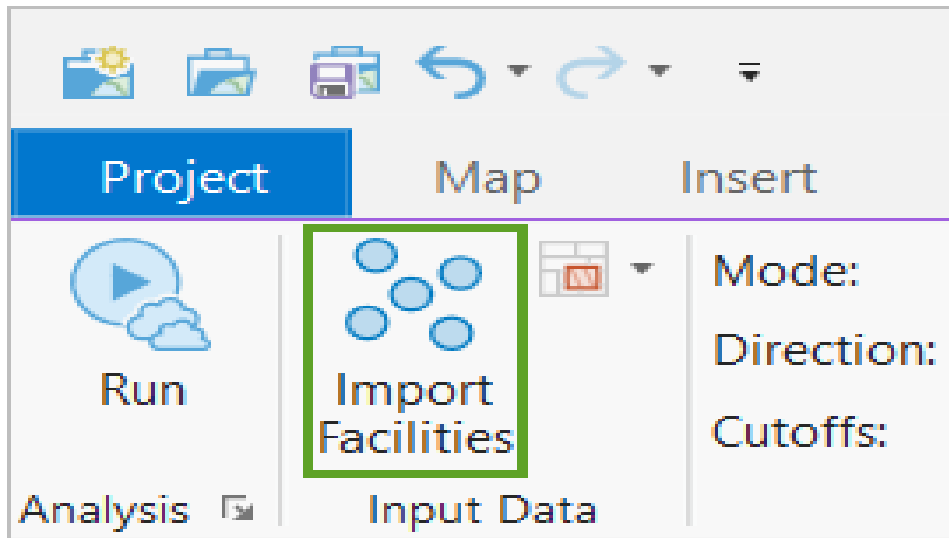


Fig 5.2 Import Facilities (self-generated)

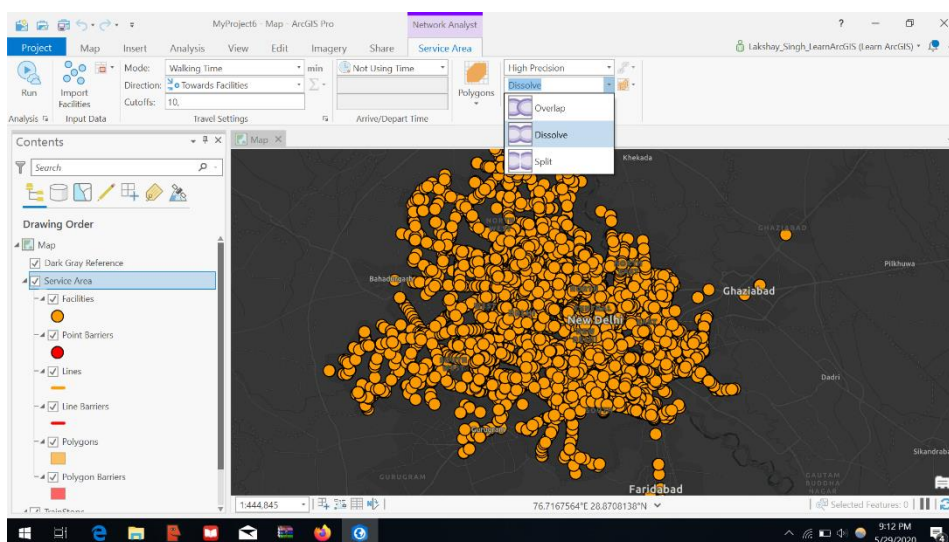


Fig 5.3 Facilities (self-generated)

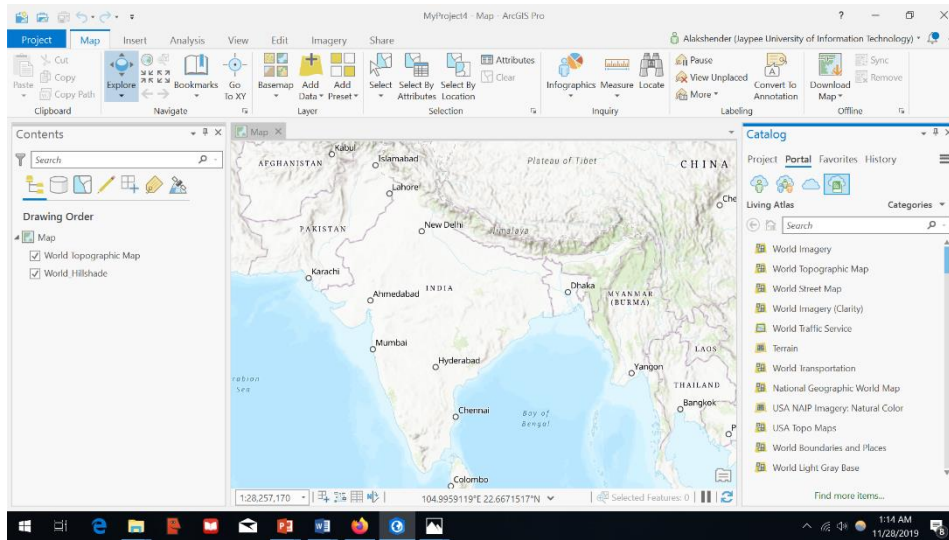


Fig 5.4 Living Atlas (self-generated)

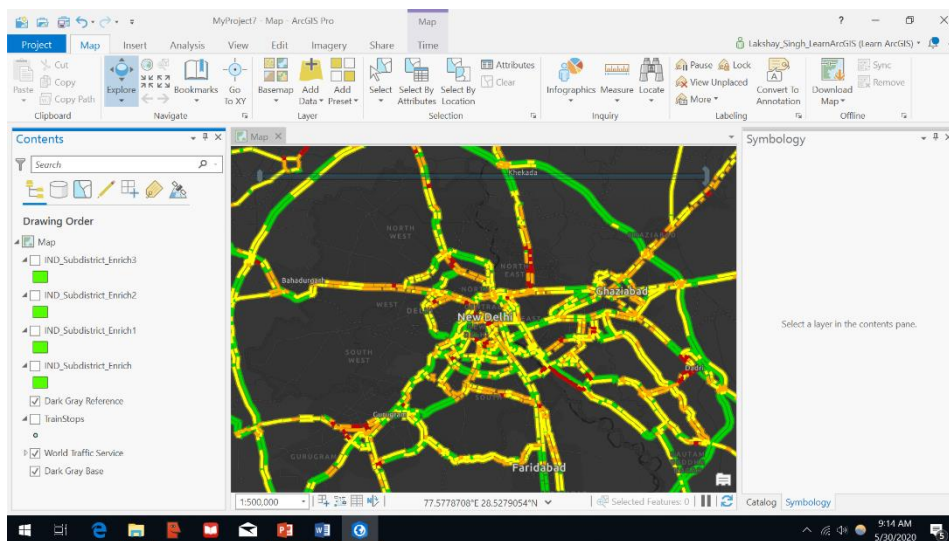


Fig 5.5 World Traffic Service (self-generated)

This layer shows the traffic conditions over the said area and gives a better idea of where to perform analysis. In the contents pane, the properties of the TrainStops layer is accessed and under definition query a new definition query is added so that only the stops over 4 sub districts are shown to work under the software limits. The next chapter discusses this process.

CHAPTER 6

NEW TRAIN ROUTE ASSESSMENT

It's started with sub districts, the second smallest geographic unit used by the Indian National Census. This layer covers the entire country, which is too large for report needs. It'll be filtered to only cover three subdistricts in New Delhi namely, Patel Nagar, Sarasvati Vihar, Civil Lines and Karol Bagh. If you click on any particular subdistrict, it's ID and name is shown.

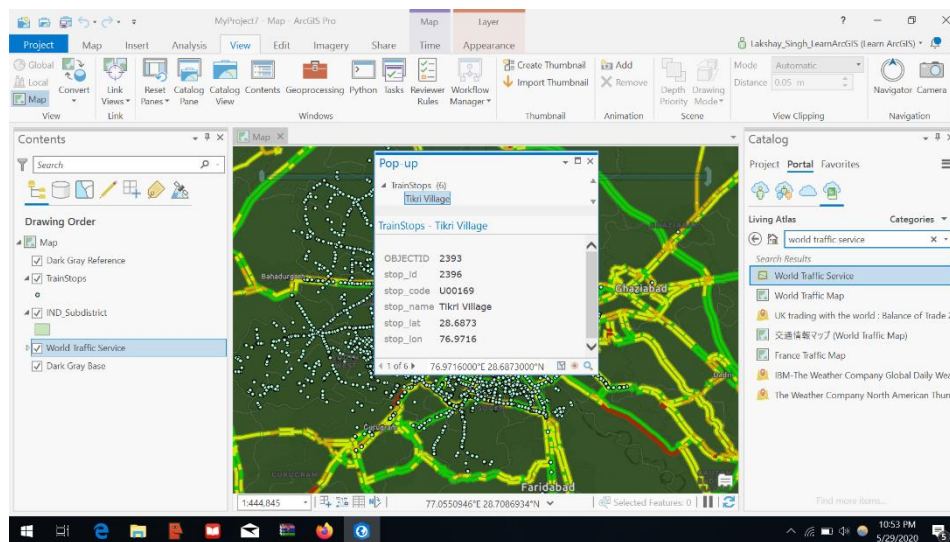


Fig 6.1 Pop up (self-generated)

Subdistrict layer in the contents pane is right clicked on. Properties>definition query>new query. Under Object ID, the object IDs for the mentioned subdistricts are added and this is shown in their pop ups. A new sub district layer will be created. Process is repeated for the newly formed layer and individual subdistrict layers are created for the districts. In the next chapter, these areas will be enriched with infographic indices like poverty and population to confirm their need for a new transit medium such as MAGLEV.

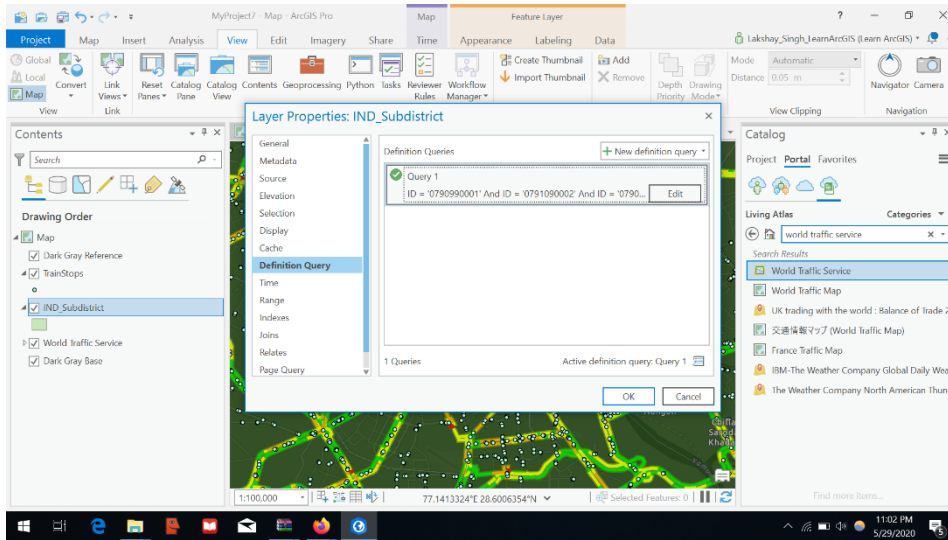


Fig 6.2 Definition query (self-generated)

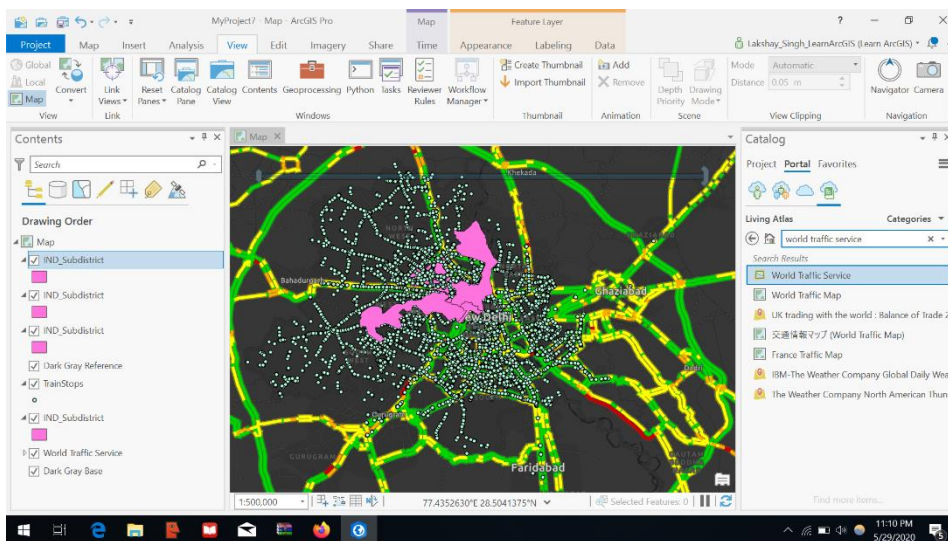


Fig 6.3 Specific subdistricts (self-generated)

CHAPTER 7

ENRICH FUNCTIONS

In the Geoprocessing pane, enrich tool is searched for, environments pane is accessed and Asia>India>Indicus Analytics is selected. Parameters are accessed and the following variables are selected: Total population, Poverty (tap water use index) and Employment (marginal workers).

In the input field, the four subdistrict layers are selected one by one and enriched with these variables. The enrich function attached demographic data to the spatial data and shows a better picture of the civil requirements of the area. Now each subdistrict layer is attached to the above mentioned variables. This helps a planner to see the demographic disparity among certain regions to make a route decision.

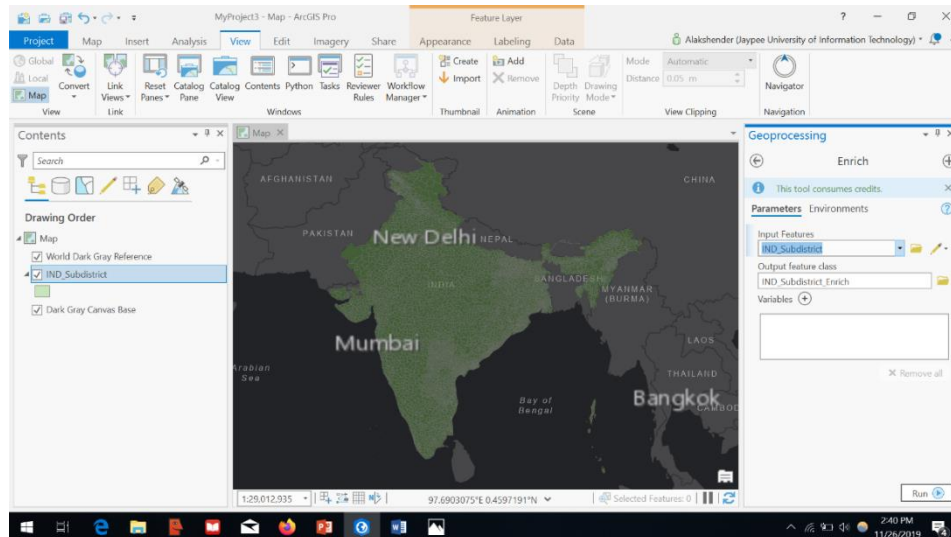


Fig 7.1 Enrich (self-generated)

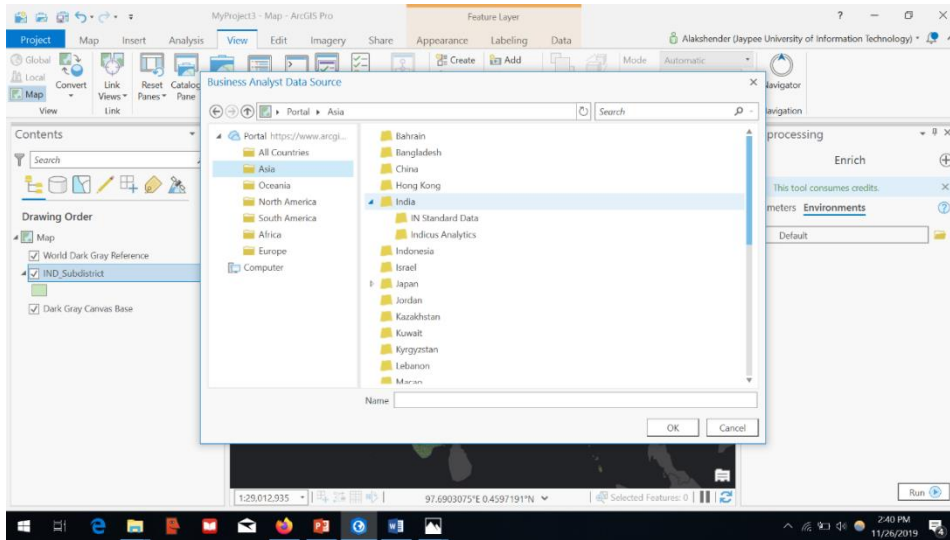


Fig 7.2 Environment Editing (self-generated)

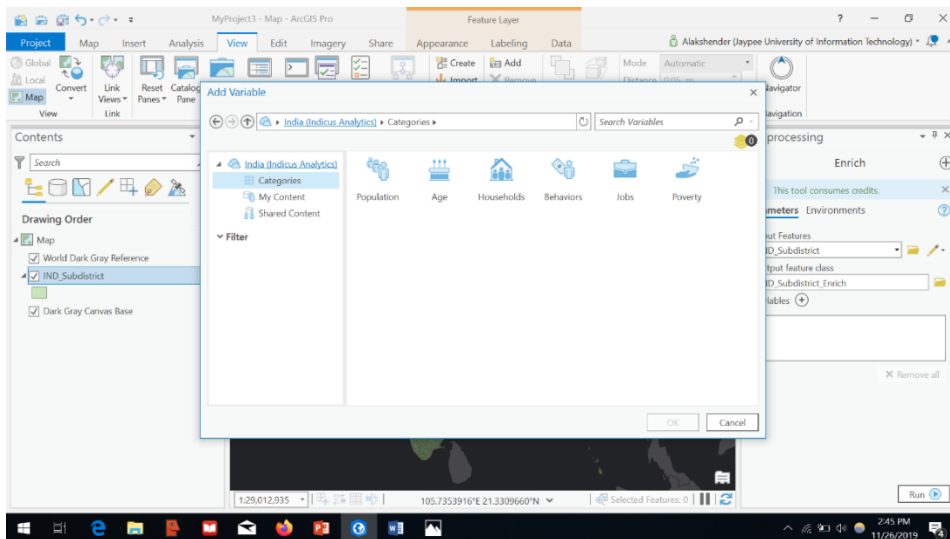


Fig 7.3 Infographic Variables (self-generated)

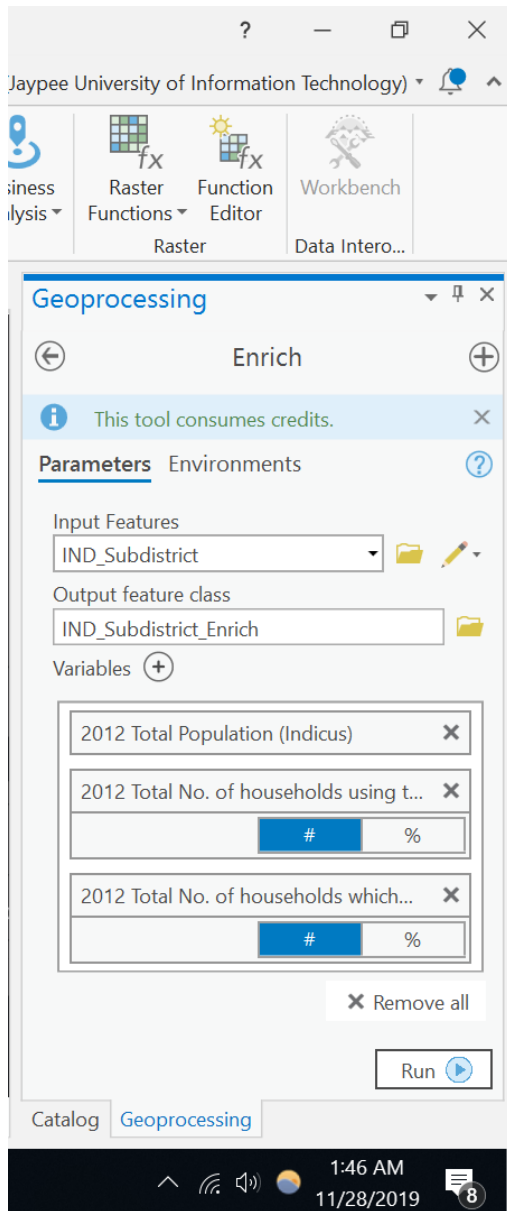


Fig 7.4 Selected Variables (self-generated)

CHAPTER 8

SYMBOLIZATION OF ENRICHED LAYER

In the previous chapter, layers were enriched with infographic variables such as population and poverty. Now this data will be represented in terms of the magnitudes of the infographic variables and compared to each other. Under the different Enriched layers in the content pane, a box representing the color is shown. That box is clicked on and a symbology pane opens up. "Vary symbology by attribute" page is accessed by clicking back key. Different color to different attribute is assigned such as Blue, Green and Pink for Population, poverty and household respectively.

Under transparency, 30 percent is selected for low values and 70% for high values. Therefore, areas with a higher magnitude of an attribute will appear brighter or more transparent. The process is repeated for each layer. Now the layers can be viewed in terms of their economic attributes.

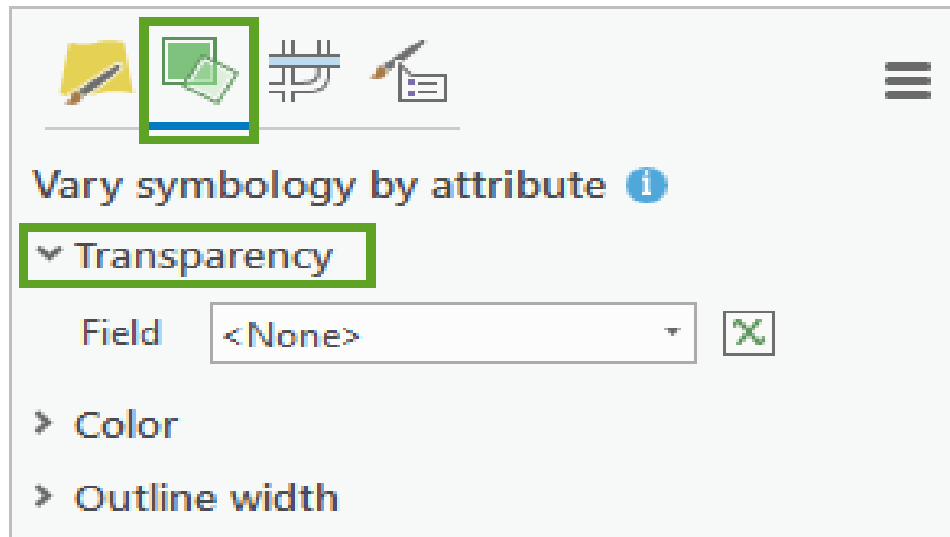


Fig 8.1 Assigning attributes (self-generated)

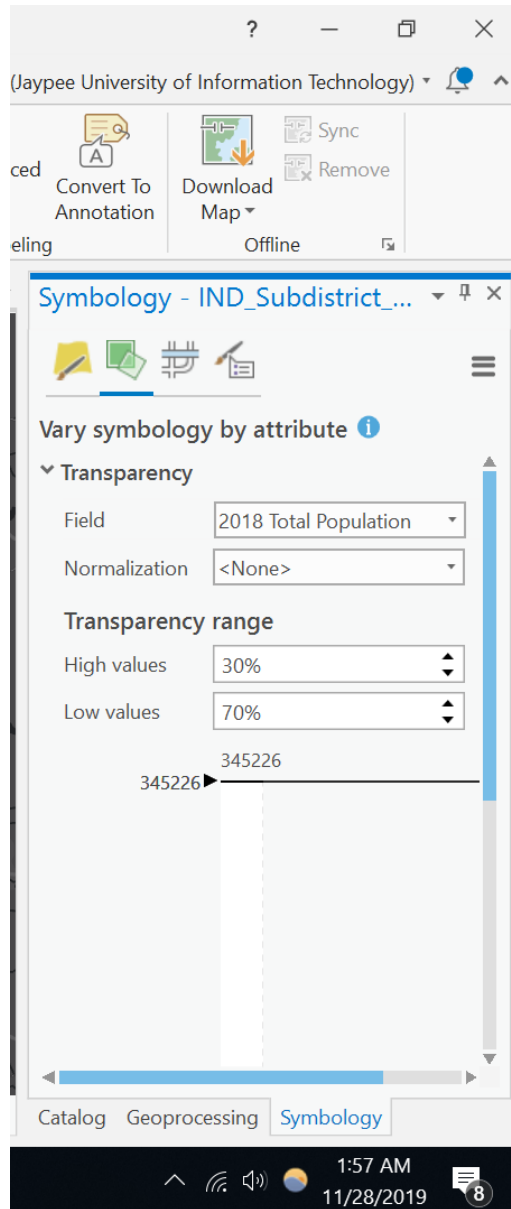


Fig 8.2 Varying attributes (self-generated)

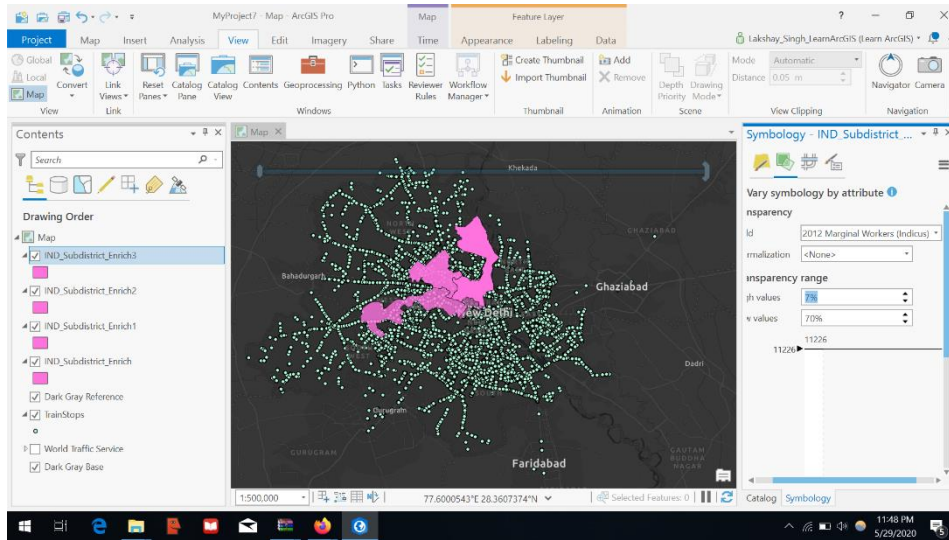


Fig 8.3 Result 1 showing subdistricts in terms of employment (self-generated)

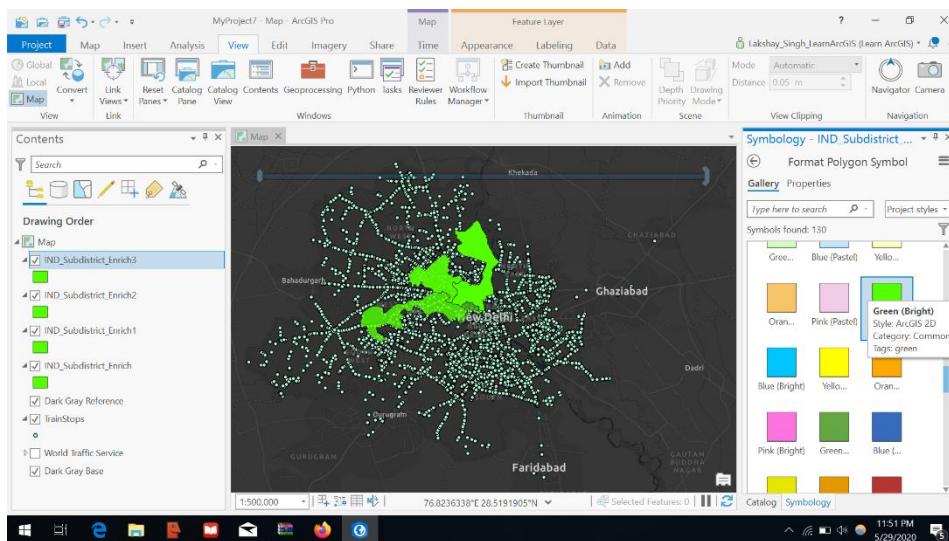


Fig 8.4 Result 2 showing subdistricts in terms of poverty (self-generated)

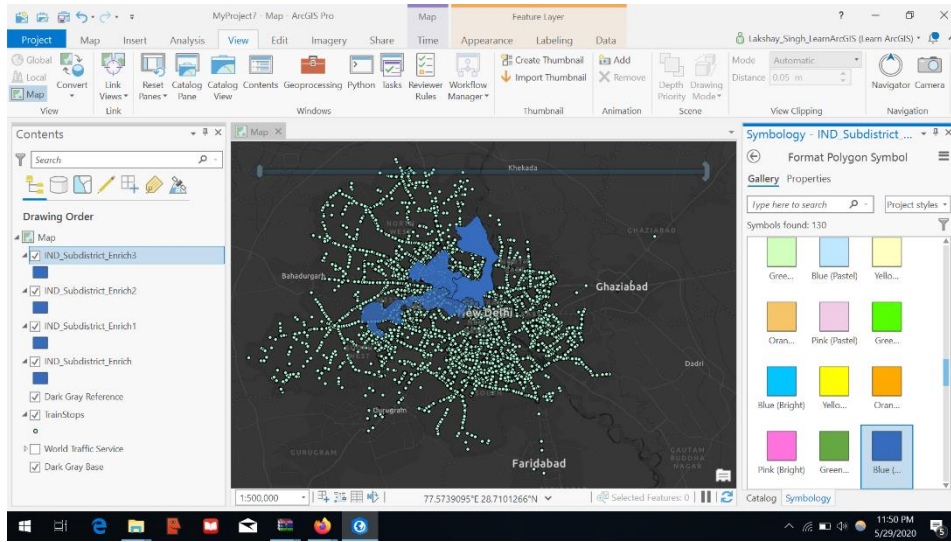


Fig 8.5 Result 3 showing subdistricts in terms of poverty (self-generated)

CHAPTER 9

Discussions and Conclusions

Every transit system is based on the requirement of a particular area. The above shown data clearly indicates that the highlighted areas are in desperate need of a new transit system. The route is high in population and high in number of impoverished households which makes it critical for transport corporations to pass a new transit project. A maglev project's initial cost is high but running costs are only a tiny fraction of the conventional railroad system and hence it can be employed in this region. The given sub districts are situated in the most commercial hub of Delhi as shown in Fig 9.1 and therefore the success of the newer transit system can only be imagined. All the 4 sub districts are densely populated and active and the traffic service layer shows clearly that traffic concentration is high in this region.

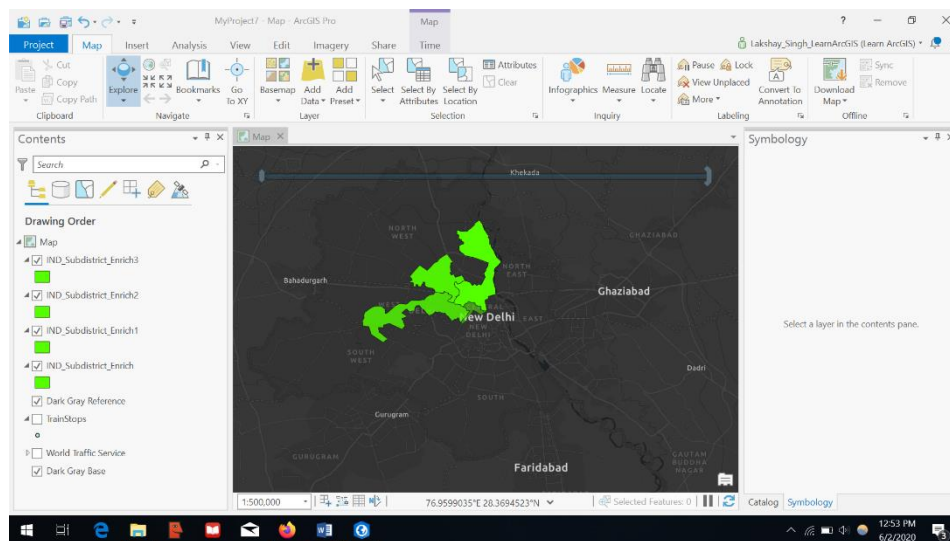


Fig 9.1 Subdistricts over a major road view of New Delhi's map (self-generated)

A maglev system is very quick, easy to construct and maintain and requires lesser excavations and hence lesser chaos and discrepancy. Plus, the route is densely populated, so it will be a successful endeavor. It has also been shown that the region around the populated stops is fairly high on traffic using the WORLD TRAFFIC SERVICE layer and therefore the traffic problems will be greatly managed in a systematic fashion. However, the process of the report formulation was far from smooth or easy and involved the following obstacles:

The software employed is an expensive one and required full purchase from my part. It was required to join ESRI's LearnGIS program and the credits provided for feature access were limited and kept getting depleted with every mistake made in the learning process. The vastness of the software and the several plugins employed required a thorough learning from my side which took more than a month since online tutorials were not easily available.

Initially the target city was supposed to be Chandigarh but the GTFS data provided by the transport corporation which is open to the public contained errors. As a result, the process mentioned in the first chapter, could not be executed and the stops were refraining from population on the map. The target location had to be changed to Delhi which proved better than the original since it is the capital and is more densely populated. The GTFS feed for Delhi was beyond the processing power of the software (1000 stops or less only) and therefore, the GTFS file and removal of the entries of several stops had to be done by accessing properties and filtering them out over the required area. However, this process was highly diligent and intuitive since there are no tutorials on a problem like this. In fact, the tutorials only led to the methodology, the execution was completely intuitive and innovative. Care was taken that only the out of station stops would be removed. Fortunately, with the correct guidance and diligence all these functional issues were tackled the given task was performed successfully. The project successfully shows that a new transit system is not only feasible but a requirement as well as a success.

India comes under the top three nations with the densest railway networks in the world but unfortunately, these networks are just usable in India and lack in many fields of operation such as: Aesthetics, Load Management, Transport Speed and Safety, Efficient fuel usage process, Proper track engineering including route formulations and Traffic management.

Study shows that the areas around Delhi with the highest traffic, population as well as poverty are not served by any modern transit system and that the Government's focus often shifts towards different areas based on political inclinations rather than engineering ones. This is why an accessibility study is necessary and more infographic information needs to be uploaded by our government on the feed network. Such studies save budget and make the projects precise and systematic giving room for a modern and modular civil structure. ArcGIS is successful in achieving the remedies of the gaps in the current system and should be used in not just Civil planning but in services planning as well by all firms in our country to achieve global levels of development.

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[2]. Clarke, K. C., 1986. Advances in geographic information systems, computers, environment and urban systems, Vol. 10, pp. 175–184.

[3]. *Roush, Wade (2012). "Welcome to Google transit: How (and why) the search giant is remapping public transportation" (PDF). Community Transportation: 3.*

[4]. *<https://transit.land/>*

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